

Progress Report to the Iowa Department of Natural Resources

Reporting Months: April – September, 2000

Contract Number: 00-6124-02

Contract Title: Phase II – Super-ESPC – Carbon Sequestration Project

Contractor: Department of Forestry, Iowa State University

Investigators: T.M. Isenhardt, C.A. Cambardella, R.C. Schultz

ARTICLE V. SCOPE OF WORK

5.1 This work applies to the carbon sequestration project located at the U.S. Fish & Wildlife Service, Neal Smith National Wildlife Refuge, Prairie City, Iowa. The Scope of Work is the sole responsibility of the Contractor and every reasonable effort will be made to complete all work on time, and to the specifications of the Department.

Substantial progress has been made in achieving outcomes outlined in the Scope of Work. No problems are anticipated in completing the project within the specified timeframe. The project was initiated through the following two organizational meetings:

- An initial project meeting was held at the Neil Smith National Wildlife Refuge on March 3, 2000 and attended by individuals from Iowa State University (ISU), USDA-ARS National Soil Tilth Laboratory, Iowa Department of Natural Resources Geological Survey Bureau, and U.S. Fish and Wildlife Service. The outcomes of this meeting were:
 - Introduction of project participants
 - Review of the genesis, evolution, and status of the project
 - Background on current monitoring projects at the Neil Smith Refuge
 - Background on Iowa State University studies on soil carbon cycling
 - Brainstorming ideas for the Walnut Creek study, including sampling strategy and analytical parameters on soil samples collected.
 - Outline of contracts, budgets, and timeline
- A second organizational meeting was held at the Neil Smith National Wildlife Refuge on April 7, 2000 and attended by individuals from Iowa State University (ISU), USDA-ARS National Soil Tilth Laboratory, Iowa Department of Natural Resources Energy and Geological Resources Division, and U.S. Fish and Wildlife Service. The outcomes of this meeting were:
 - Refinement of sampling strategy and soil assays
 - Determination of method to be used for establishing and locating sampling sites.

5.2 The Contractor will select specific locations, to be sited at the Neal Smith Prairie Center, in which to develop, research, test, and analyze the technologies involving carbon management and sequestration. Collecting, exploring and evaluating project soil sample data will aid in research development and assist the researchers in providing information dissemination of project results.

Specific objectives of this project are to:

- estimate carbon sequestration within similar soils under different vegetation (annual row crops, restored/reconstructed prairie, remnant prairie, and savanna) within the Neal Smith National Wildlife Refuge
- determine the effect of time since prairie reestablishment on soil carbon accumulation
- assess the effect of burning as a prairie management strategy on soil carbon accumulation

All sampling sites are located within the Neal Smith National Wildlife Refuge. Project investigators consulted with staff of the Iowa State University Department of Statistics on final sampling design. It was decided that in order to accomplish project objectives within the resources available and to reduce variability, that sampling sites within each treatment be blocked by common soil series [Tama (120B) or Otley (281B)] (Appendix 1). To select sites, geographic information system (GIS) coverages of possible sampling sites were created by personnel from the IDNR Geological Survey Bureau. An Arcview area grid and random number generator was then used to select sampling locations, which were distributed proportionally to the size of the site. Global Positioning System (GPS) coordinates of sampling locations were generated to assist in sample site location (Appendix 1).

Global Positioning System (GPS) coordinates of sampling locations generated by the IDNR Geological Survey Bureau were used to locate and mark sampling sites within the Neal Smith National Wildlife Refuge on May 17-18. Soil samples were collected during the week of May 22-26, 2000. Samples were collected to a depth of 40 inches. Two truck-mounted Giddings soil samplers were used to collect samples within the cropped fields and restored prairie sites. These soil cores were sectioned into five depths in the field and stored in plastic bags at 4°C until processed. In savanna areas inaccessible by truck, modified Giddings soil tubes inserted with a gasoline-powered jackhammer were used to collect intact soil cores. Upon return to the laboratory, intact cores were stored at 4°C until sectioned and processed.

Samples from the cropped fields and restored prairies were all taken from either Tama (120B) or Otley (281B) soil series. These series are very similar and consist of well to moderately well drained soils on convex ridgetops and side slopes. These soils formed in loess under grass and slopes are from 0 to 9 percent. In a representative profile, the surface layer is black, very dark brown or very dark gray silty clay loam 15-18 inches thick. The subsoil extends to a depth of 42-50 inches and is friable silty clay loam. This is underlain by yellowish brown silty clay loam.

Soils from the savanna sites were sampled within the Ladoga Series (76D2). This series consists of moderately well drained soils on the uplands. These soils formed under deciduous trees and tall prairie grasses. Slopes are from 2 to 14 percent. In a representative profile the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown and grayish brown silt loam about 5 inches thick. The subsoil is brown, friable to firm silty clay loam that extends to a depth of 60 inches.

By project completion, soils will be assayed for bulk density, texture, total organic carbon, total organic nitrogen, and a subset (surface soils) for particulate organic matter. Project personnel are

well into processing the approximately 600 soil samples. Sample processing includes the following:

- Soil samples were first sieved through an 8 mm sieve and rocks and large roots removed. (completed)
- Field moisture was assessed gravimetrically on a subsample by difference in weight after drying at 105°C. (completed)
- Samples were sieved through a 2 mm sieve and air dried. (completed)
- Soil bulk density (ratio of the mass of dry solids to the bulk volume of the soil) was determined after drying to a constant weight at 105°C. (completed)
- Total carbon and nitrogen was analyzed by high-temperature combustion using a Carlo Erba NA1500 Carbon/Nitrogen/Sulfur analyzer. A representative subsample (<50 mg) of soil is weighed into a tin boat for introduction into the instrument. (completed)
- Soil samples from the top two depths are currently being assayed for particulate organic matter (POM). POM is a biologically active form of soil organic matter that is isolated using physical fractionation. POM is considered to be a good indicator of soil quality because it responds rapidly and selectively to changes in land use and soil management. However, due to the unique characteristics of soils collected within the restored prairies at the Neal Smith Refuge, including the presence of charcoal, some modifications in methods have been necessary. (ongoing)
- Soil samples are also currently being analyzed for particle size (texture), which is a measurement of the size distribution of individual particles in a soil sample. (ongoing)

Soil collections on the Neal Smith Refuge in 2000 did not include remnant prairie sites as identified in the initial sampling design. Attempts to locate high-quality remnant prairies on Tama-Ottley soils within a several county area adjacent to the Refuge were unsuccessful. It was decided to sample several remnant prairie sites on Ladoga soils within the Refuge and Global Positioning System (GPS) coordinates of sampling locations were generated by the IDNR Geological Survey Bureau. Soil collection was undertaken on July 27 with good cores obtained from “Remnant 1” located near the Neal Smith Visitor Center. However, “Remnant 2”, located in the eastern part of the refuge, was determined to be too small and disturbed to be representative of a remnant prairie and no cores were collected at this location. Project personnel are currently assessing options for additional soil collection within remnant prairie locations on the Refuge. Options include collecting additional soil cores on “Remnant 1” .

5.3 This model will focus on the impacts and benefits of carbon sequestration, its affects on society and the environment, and provide energy-saving data in the early stages of the program. Results will be expected to demonstrate energy savings / energy-based contributions and create opportunities for future research. The success of this innovative pilot project will encourage future opportunities in education and prove other federal facilities, nationwide, can use this research for development of hands-on, educational purposes at their facilities.

Not applicable this reporting period

5.4 Project goals will be to provide recommendations for future land use changes, illustrate enhanced land management, and possibly reveal new prairie conservation practices such as prairie as a crop and buffers. Measurable results of this program will show reduced maintenance (low-mow), demonstrate up front loading of human energy, prairie restoration, provide opportunities for promotional/informational activities, develop baseline data for carbon sequestration for use by others, and also illustrate carbon sequestration application to the possibility of carbon trading.

Not applicable this reporting period

5.5 The Department will provide funds, up to but not in excess of the contract amount, to complete an environmental analysis, for development of this project and to provide other professional services which may include labor, graduate student work, and other research educational opportunities, relating to the selected carbon sequestration project. The Department will provide assistance in financing to support the mission of this project.

Graduate and undergraduate students have been actively involved in the project under the direction of project principal investigators. Initially, two students who had completed their undergraduate degrees and were to start their graduate work in the Fall of 2000 were assigned primary oversight responsibility for soil sample preparation. One of these students continues to be involved in the project and is currently overseeing particle size analysis. Approximately ten other undergraduate and graduate students have also contributed to the project either in soil sample collection or preparation and analysis.

Appendix

Table 1. Locations sampled within the Neal Smith National Wildlife Refuge. Years included in plot ID refers to the year the site was planted to prairie.

Plot ID	Soil Series	Treatment	Acres	Percent Total Trt.	No. of Samples
1993-1	120B	Unburned	2.3	100	10
1994-1	120B	Unburned	14.2	43	5
1994-2	281B	Burned	31.7	100	6
1994-3	281B	Unburned	18.5	57	5
1995-1	120B	Unburned	6.6	63	6
1995-2	120B	Unburned	2.2	37	4
1995-3	120B	Burned	11.4	100	10
1997-1	281B	Unburned	6.1	54	5
1997-4	281B	Unburned	4.6	47	5
1997-2	281B	Burned	12.3	100	10
1998-1	120B	Unburned	7.9	35	3
1998-2	281B	Unburned	28.3	65	7
1998-3	281B	Burned	23.6	100	10
2000-1	281B	Unburned	5.3	100	10
Farm-1	120B		28.3	67	7
Farm-2	120B		6.6	33	3
Savanna-1	76D2		7.3	61	6
Savanna-2	76D2		3	39	4

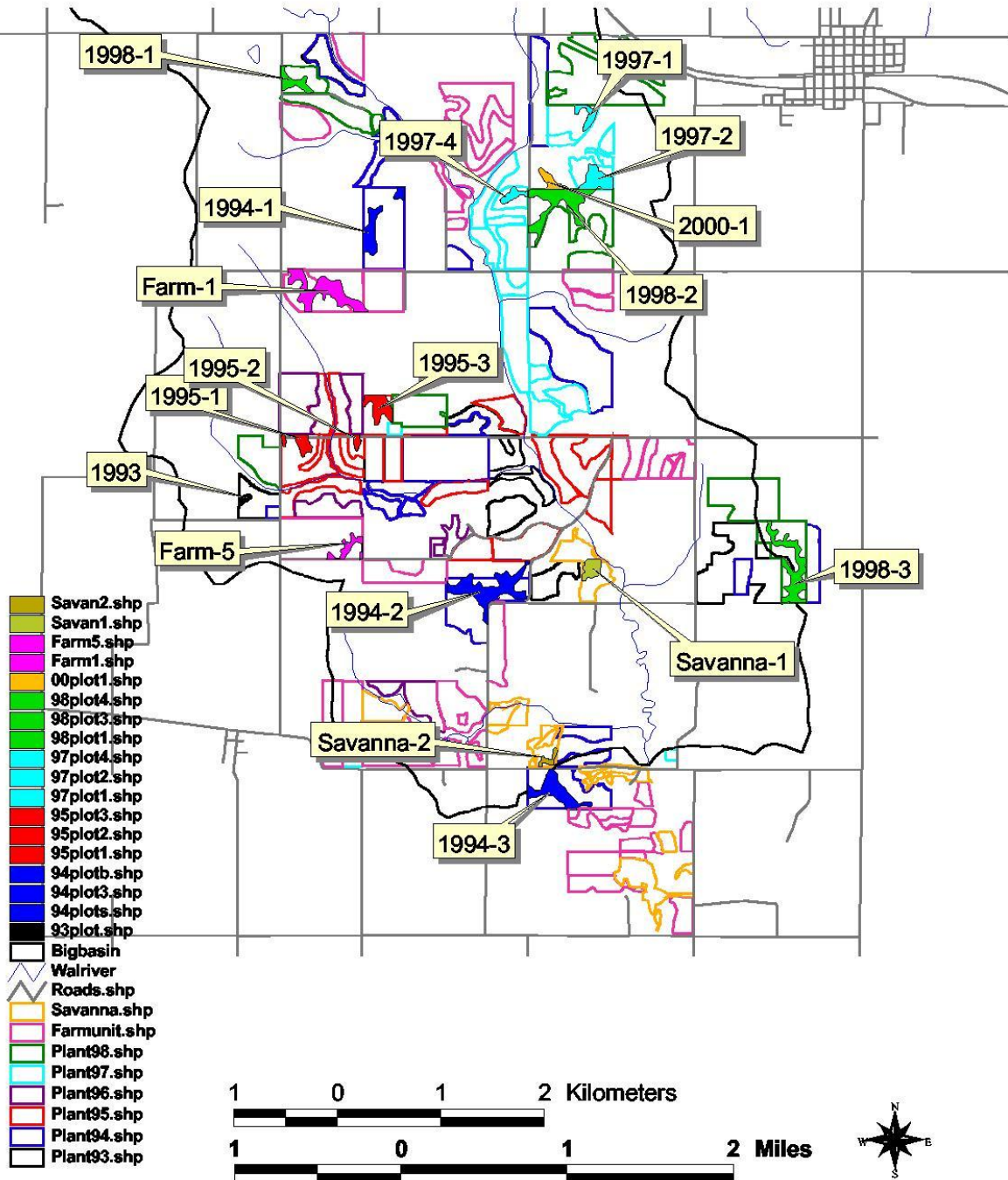
Table 2. Global Positioning Coordinates of Sample Sites at the Neal Smith National Wildlife Refuge

Location		
93-1-1	93.3058	41.5601
93-1-2	93.3053	41.5603
93-1-3	93.3056	41.5603
93-1-4	93.3058	41.5604
93-1-5	93.3052	41.5604
93-1-6	93.3056	41.5605
93-1-7	93.3053	41.5606
93-1-8	93.3047	41.5606
93-1-9	93.3057	41.5607
93-1-10	93.3051	41.5608
94-1-1	93.2909	41.5824
94-1-2	93.2907	41.5828
94-1-3	93.2905	41.583
94-1-4	93.2913	41.5831
94-1-5	93.2914	41.5834
94-1-6	93.2912	41.5838
94-1-7	93.2912	41.5842
94-1-8	93.2906	41.5847
94-1-9	93.2905	41.5855
94-1-10	93.2896	41.5858
94-2-1	93.2771	41.5516
94-2-2	93.2772	41.5523
94-2-3	93.2771	41.5525
94-2-4	93.2804	41.553
94-2-5	93.2798	41.5533
94-2-6	93.2751	41.5538
94-3-1	93.2668	41.534
94-3-2	93.2683	41.5347
94-3-3	93.2702	41.5351
94-3-4	93.2695	41.5359
95-1-1	93.2988	41.5647
95-1-2	93.2982	41.5651
95-1-3	93.2988	41.5654
95-1-4	93.3009	41.5658
95-1-5	93.2992	41.566
95-1-6	93.2989	41.5661
95-2-1	93.2921	41.5652
95-2-2	93.2923	41.5654
95-2-3	93.2926	41.5657
95-2-4	93.2926	41.5659
95-3-1	93.2901	41.5673
95-3-2	93.2903	41.5677

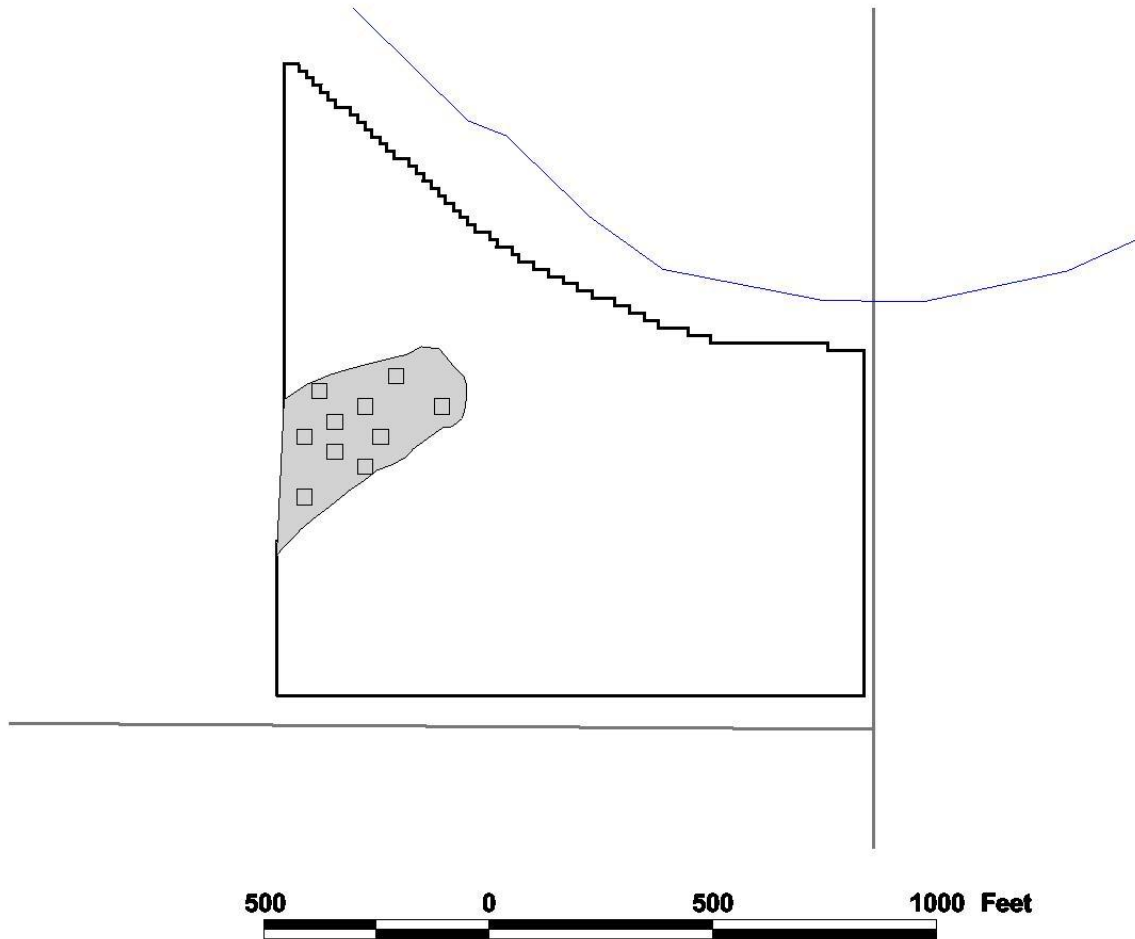
95-3-3	93.2891	41.5681
95-3-4	93.2897	41.5683
95-3-5	93.2892	41.5684
95-3-6	93.2889	41.5689
95-3-7	93.2888	41.569
95-3-8	93.2905	41.5692
95-3-9	93.2899	41.5692
95-3-10	93.2894	41.5695
97-1-1	93.2656	41.5931
97-1-2	93.2653	41.5935
97-1-3	93.2671	41.5942
97-1-4	93.2653	41.5944
97-1-5	93.2663	41.5948
97-4-1	93.2755	41.5867
97-4-2	93.2745	41.5868
97-4-3	93.2741	41.587
97-4-4	93.2731	41.5873
97-4-5	93.2741	41.5875
97-2-1	93.2659	41.5877
97-2-2	93.2655	41.5878
97-2-3	93.264	41.5881
97-2-4	93.2646	41.5883
97-2-5	93.2654	41.5885
97-2-6	93.2649	41.5885
97-2-7	93.2657	41.5886
97-2-8	93.2629	41.5886
97-2-9	93.2651	41.5889
97-2-10	93.2646	41.5892
98-1-1	93.2985	41.5965
98-1-2	93.3009	41.597
98-1-3	93.3009	41.5975
98-2-1	93.2717	41.5843
98-2-2	93.2668	41.5847
98-2-3	93.2704	41.5856
98-2-4	93.268	41.5865
98-2-5	93.2708	41.5871
98-2-6	93.2664	41.5874
98-2-7	93.2672	41.5875
98-3-1	93.2424	41.5519
98-3-2	93.2417	41.5521
98-3-3	93.2408	41.5528
98-3-4	93.2409	41.5536
98-3-5	93.2408	41.5546
98-3-6	93.2414	41.5567
98-3-7	93.2419	41.5567
98-3-8	93.2432	41.5569






98-3-9	93.244	41.5573
98-3-10	93.2443	41.5585
00-1-1	93.2695	41.5877
00-1-2	93.2688	41.5878
00-1-3	93.2697	41.5879
00-1-4	93.2696	41.5881
00-1-5	93.2699	41.5883
00-1-6	93.2704	41.5886
00-1-7	93.2699	41.5886
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00-1-10	93.2712	41.5893
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fm-1-2	93.2979	41.5777
fm-1-3	93.2986	41.5783
fm-1-4	93.295	41.5787
fm-1-5	93.2964	41.5796
fm-1-6	93.3	41.5798
fm-1-7	93.299	41.5801
fm-5-1	93.2955	41.5555
fm-5-2	93.293	41.5564
fm-5-3	93.292	41.5569
sv-1-1	93.266	41.5537
sv-1-2	93.2655	41.554
sv-1-3	93.265	41.5544
sv-1-4	93.2652	41.5549
sv-1-5	93.2642	41.555
sv-1-6	93.2651	41.5553
sv-2-1	93.271	41.5375
sv-2-2	93.27	41.5377
sv-2-3	93.2694	41.5378
sv-2-4	93.2692	41.5384

All sites



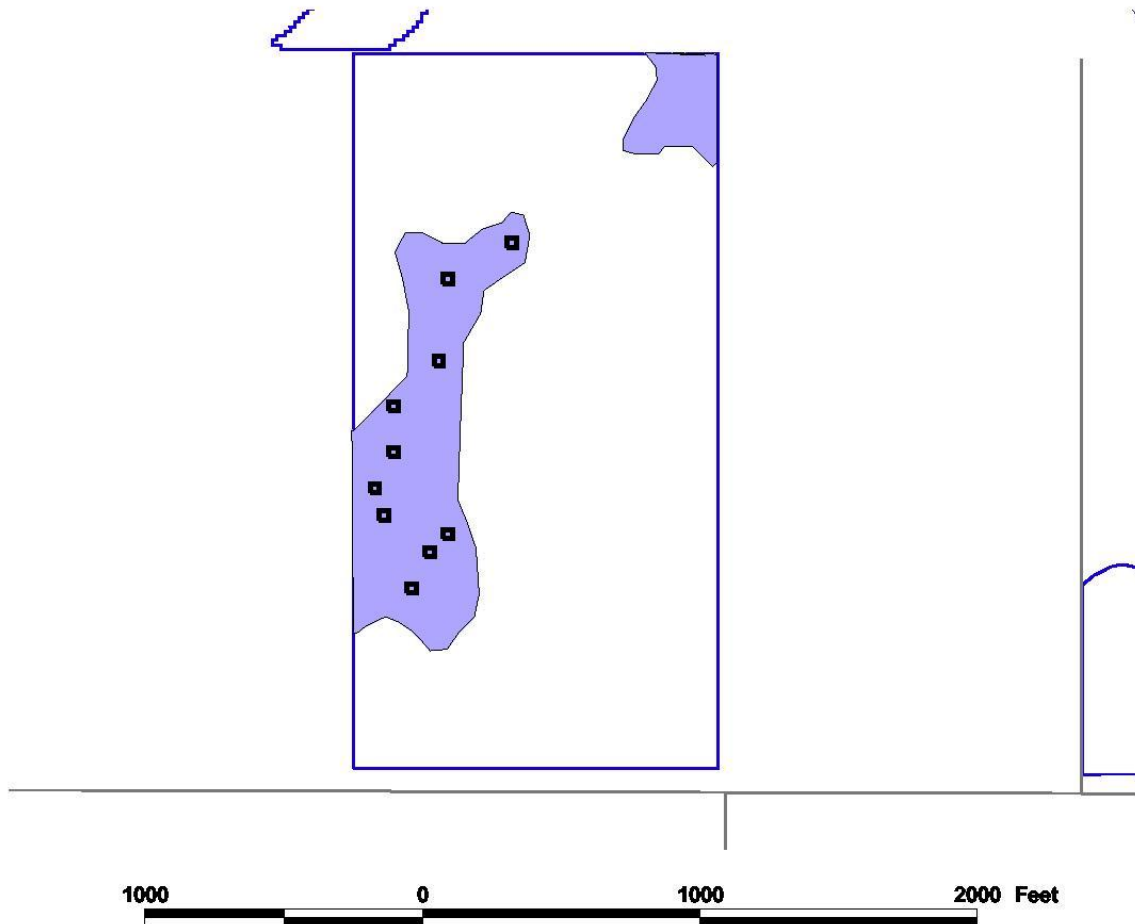
1993 Plot








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-  **Walriver**
-  **Roads.shp**



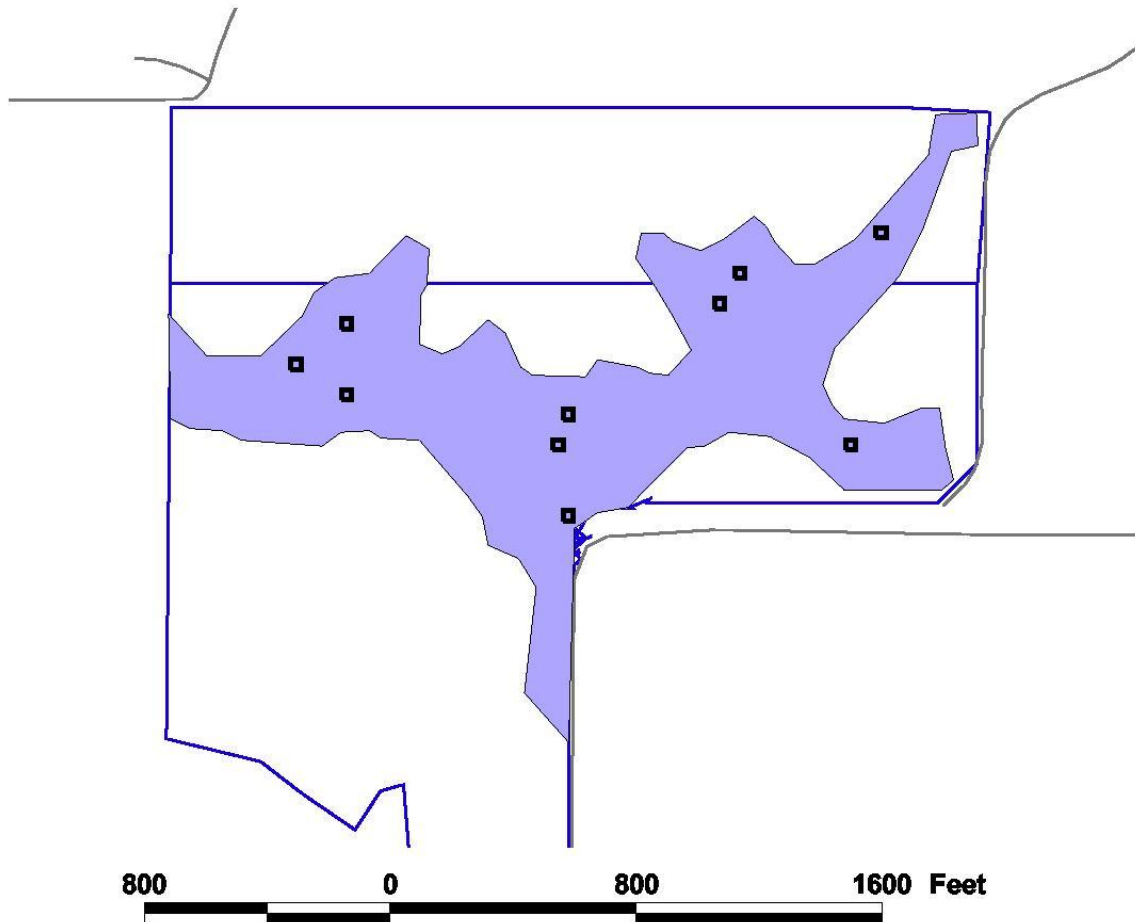
1994-1 Plot (Unburned)








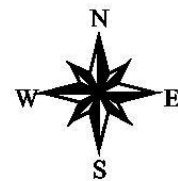
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-  **Walriver**
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-  **Plant94.shp**



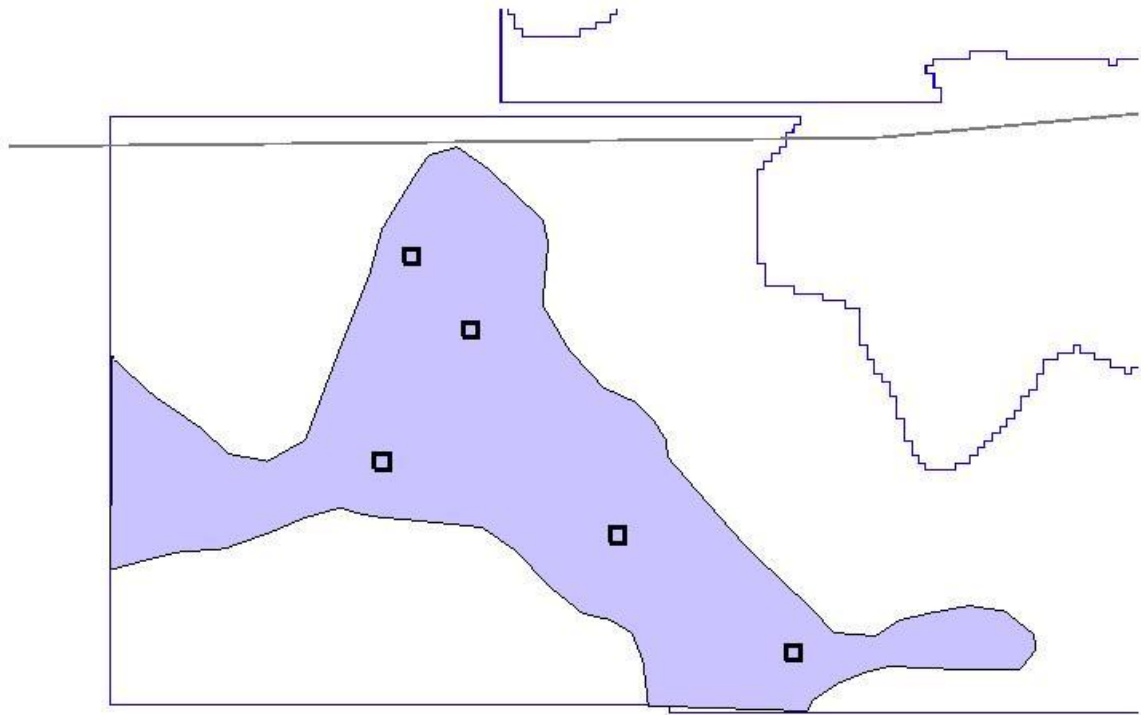
1994-2








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-  **Walriver**
-  **Roads.shp**
-  **Plant94.shp**



1994-3

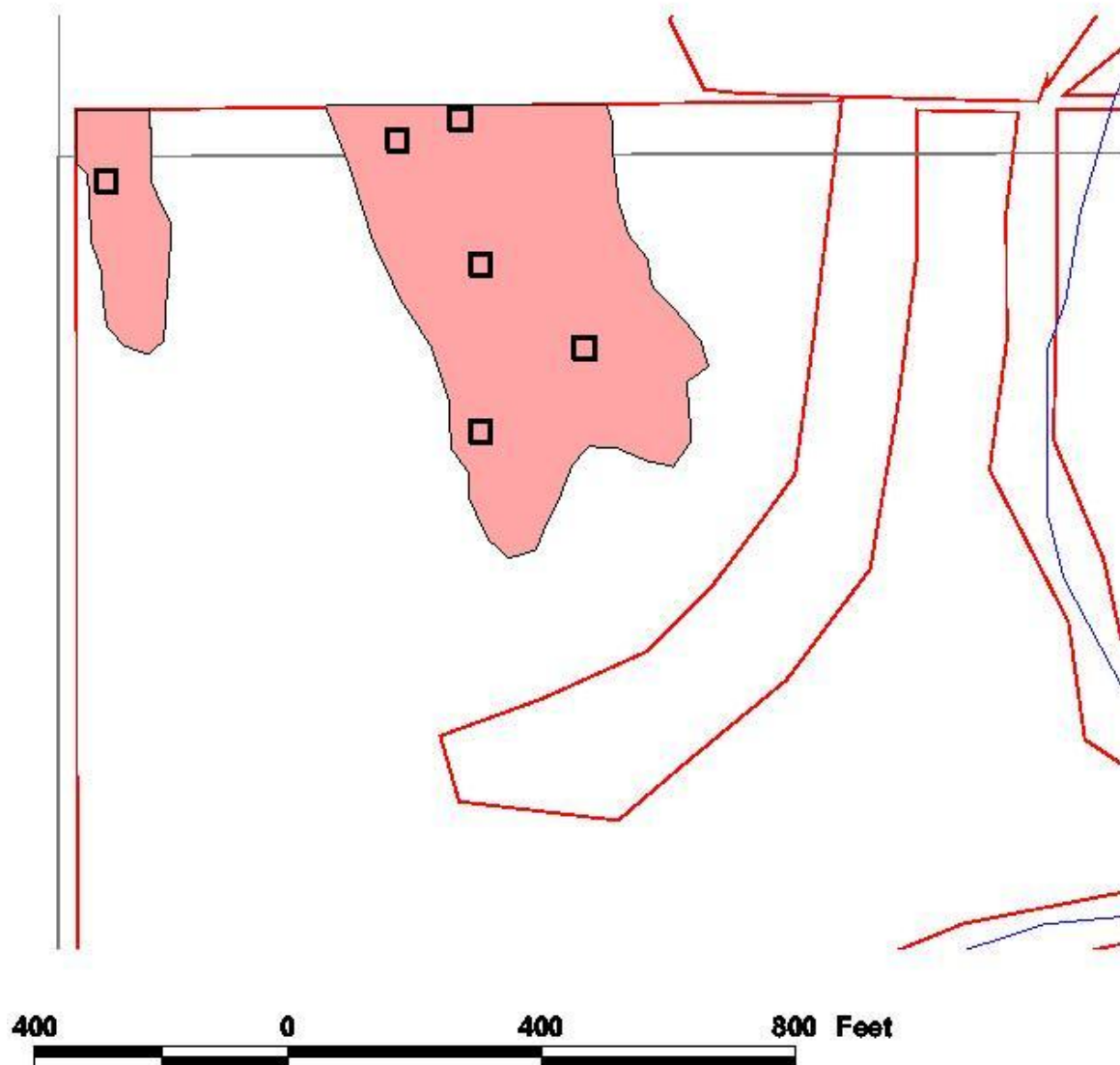







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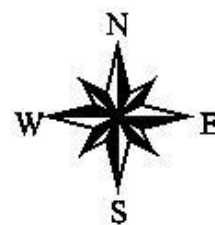
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-  Soil 281B
-  Walriver
-  Roads.shp
-  Plant94.shp



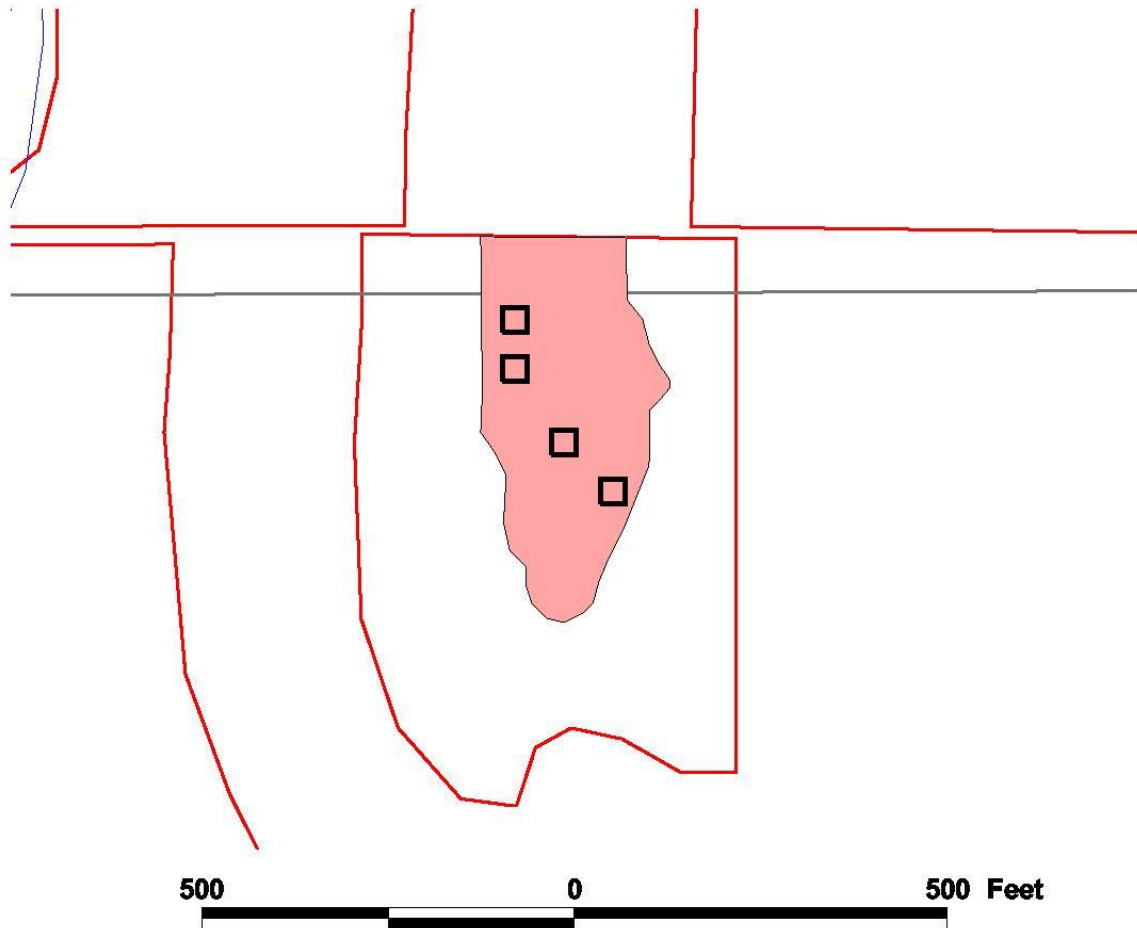
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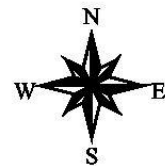
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-  **Walriver**
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-  **Plant95.shp**



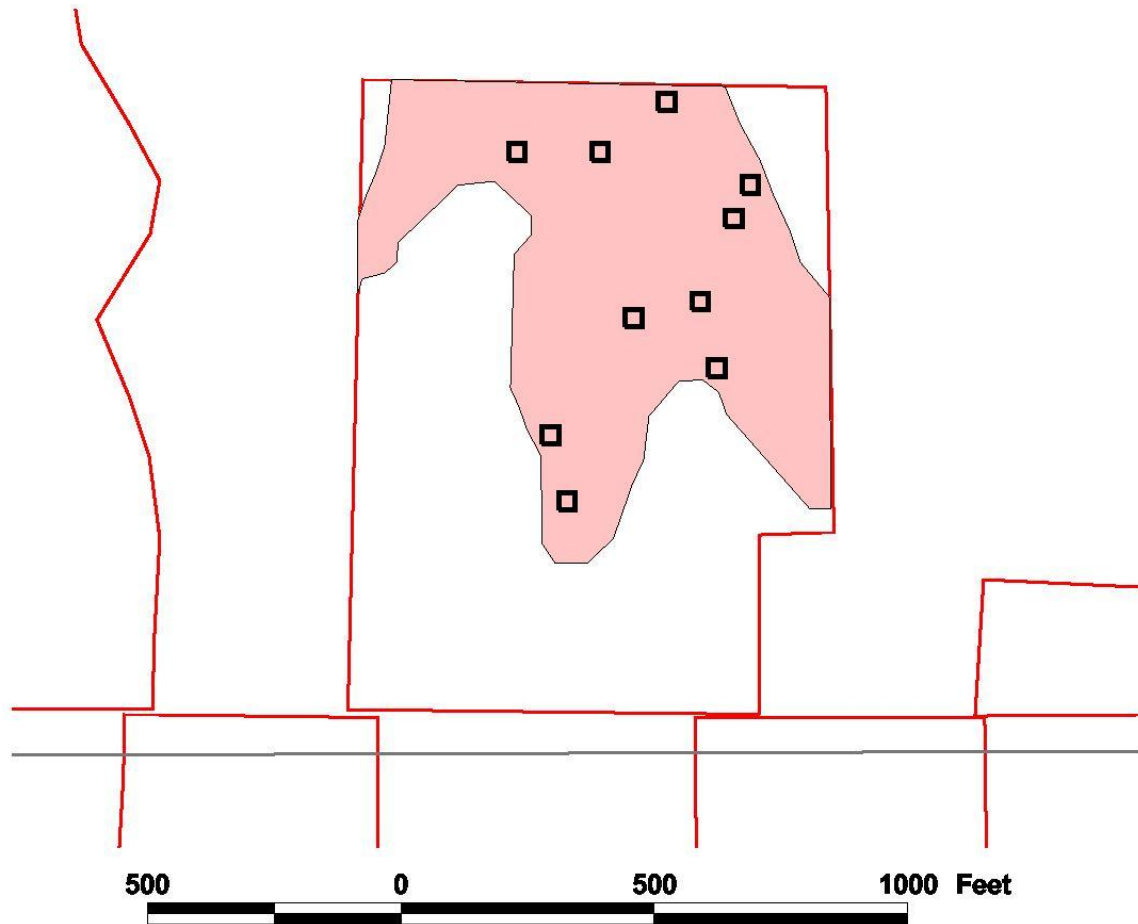
1995-2








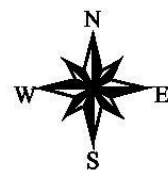
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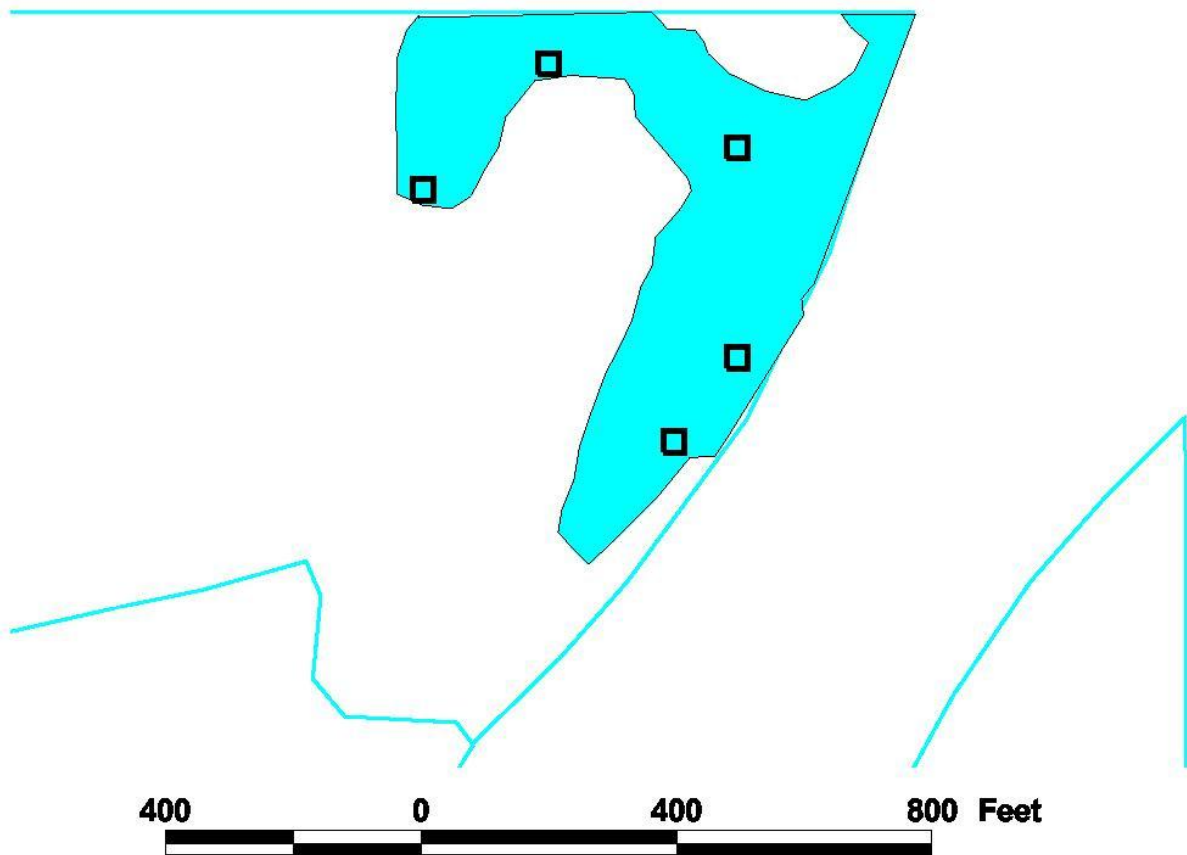
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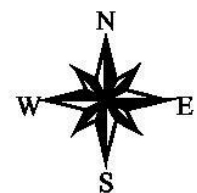
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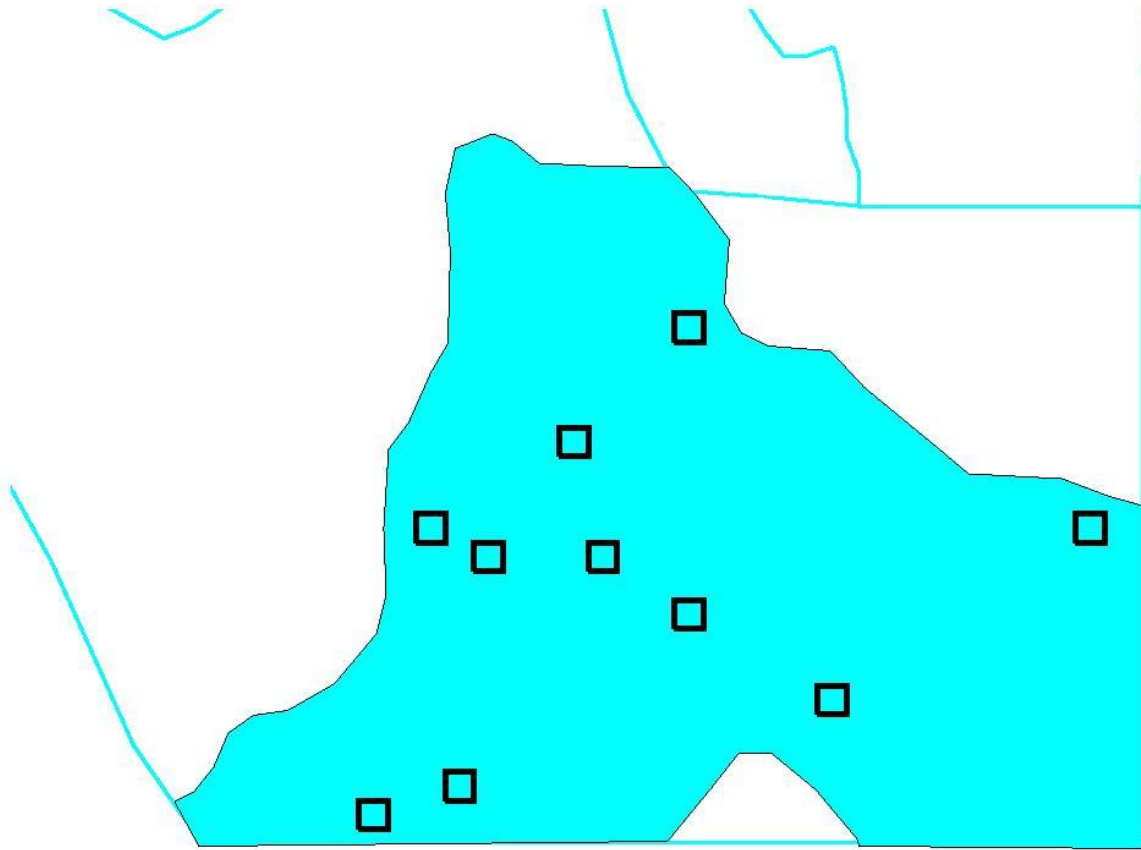
1997-1








-  **Sample Points**
-  **Soil 281B**
-  **Roads.shp**
-  **Plant97.shp**

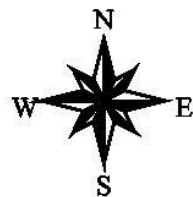


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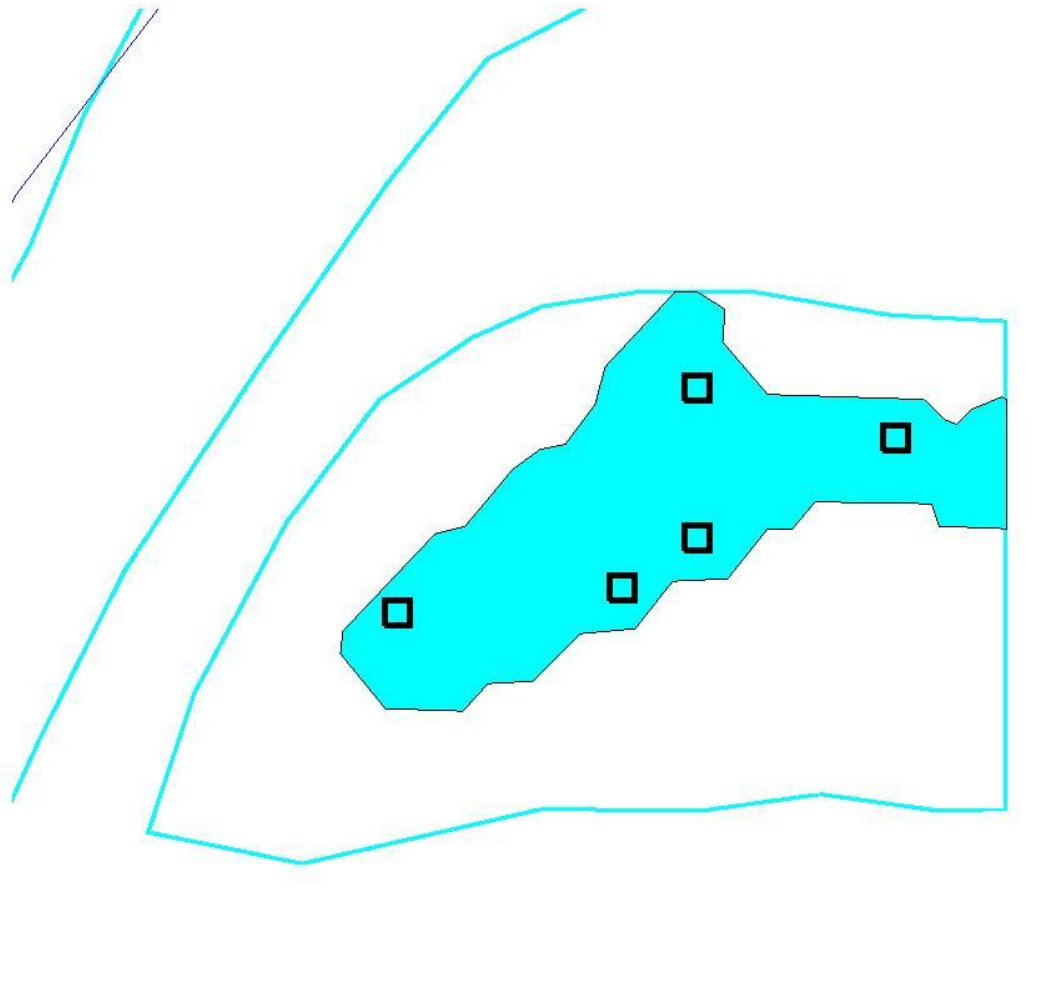


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-  **Sample Points**
-  **Soil 281B**
-  **Walriver**
-  **Roads.shp**
-  **Plant97.shp**

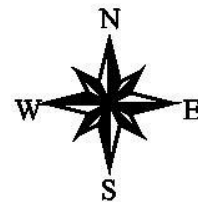


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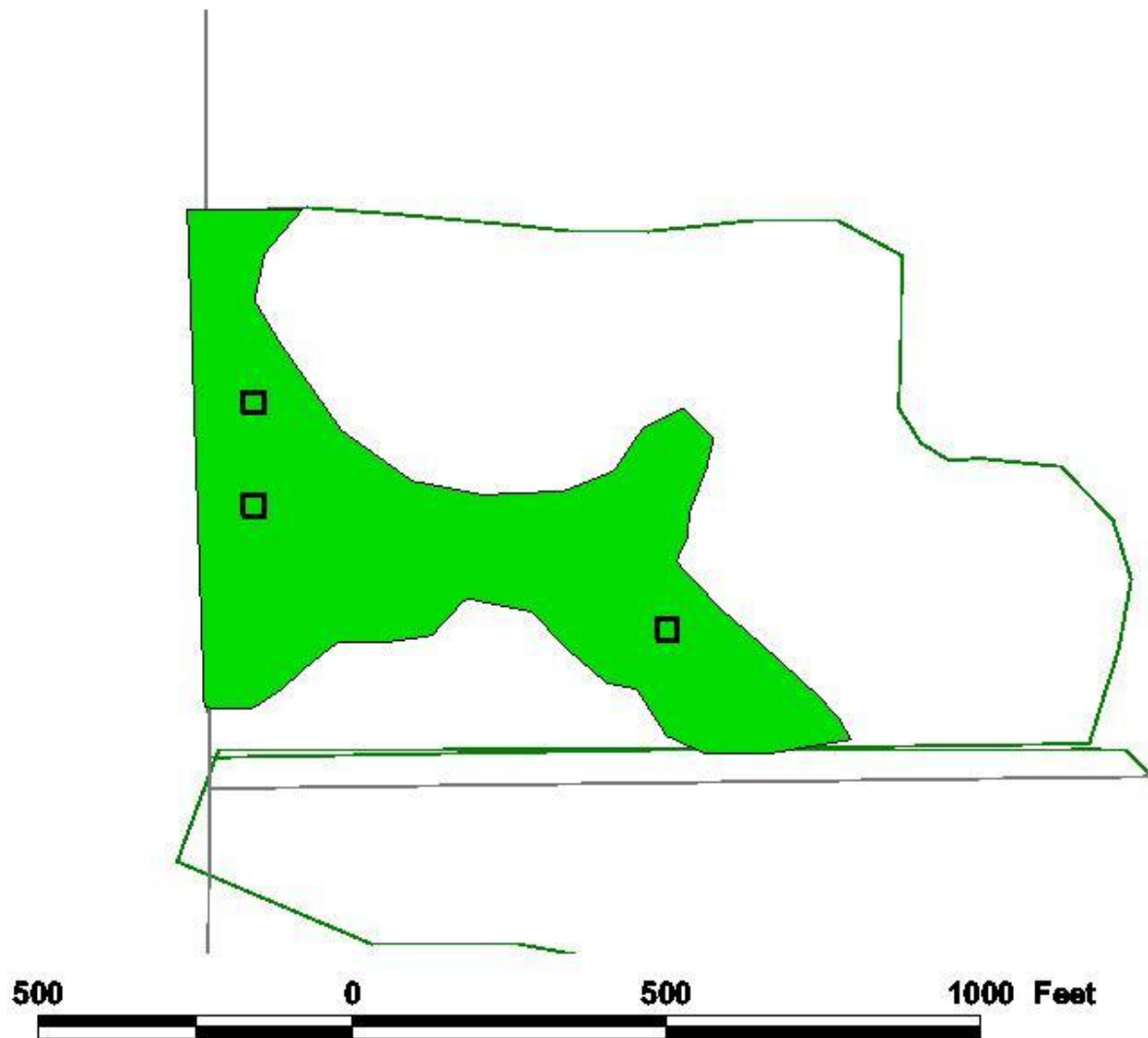


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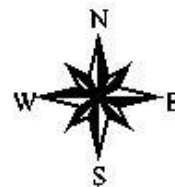
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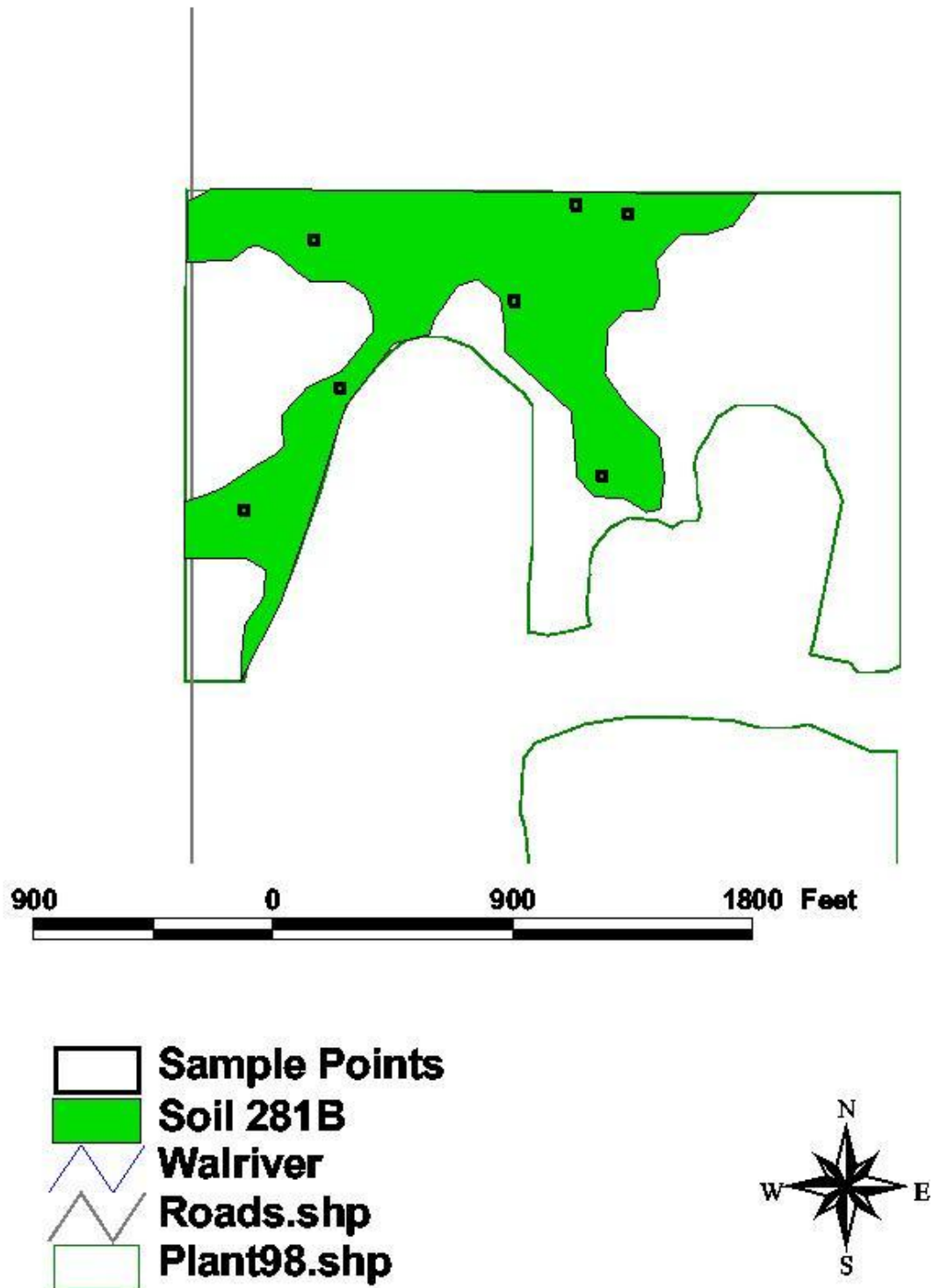
1998-1



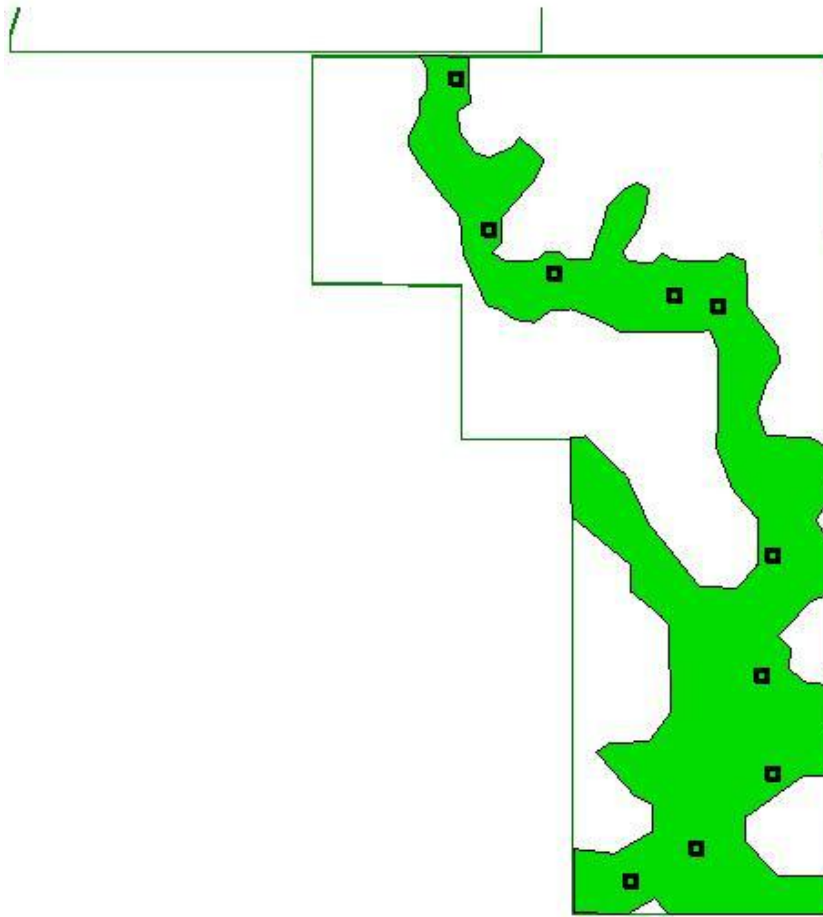
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-  **Plant98.shp**



1998-2



1998-3

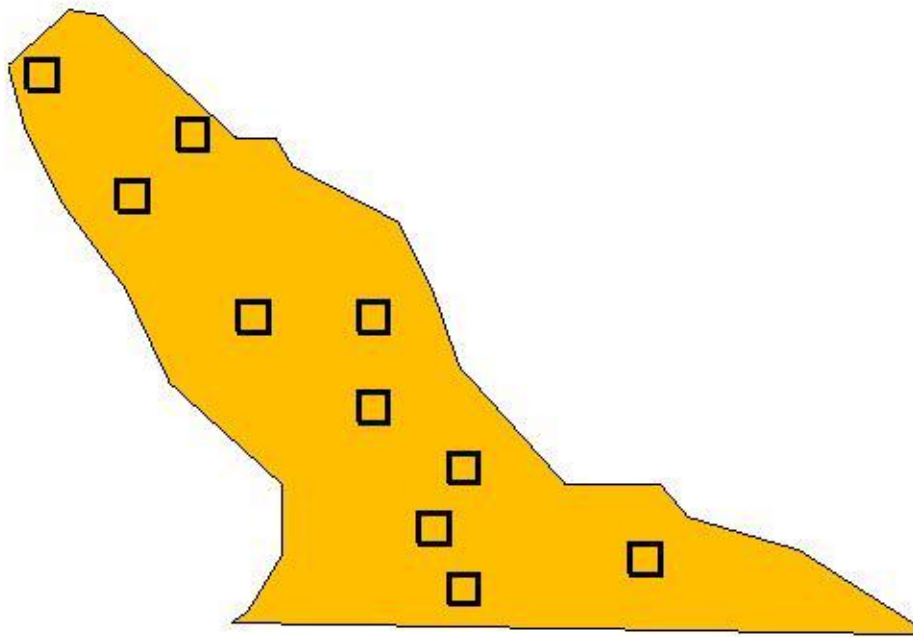


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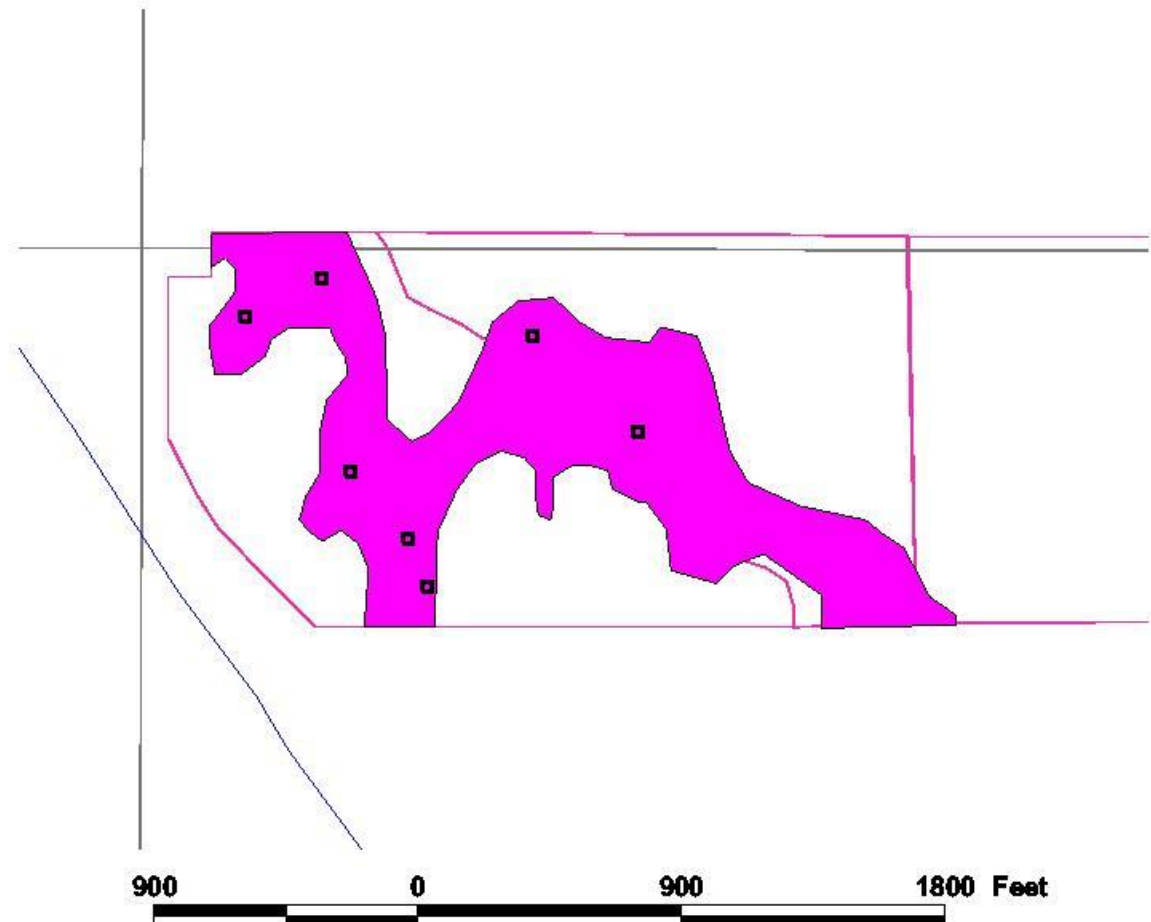
- Sample Points
- Soil 281B
- Walriver
- Roads.shp
- Plant98.shp



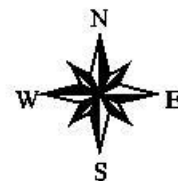
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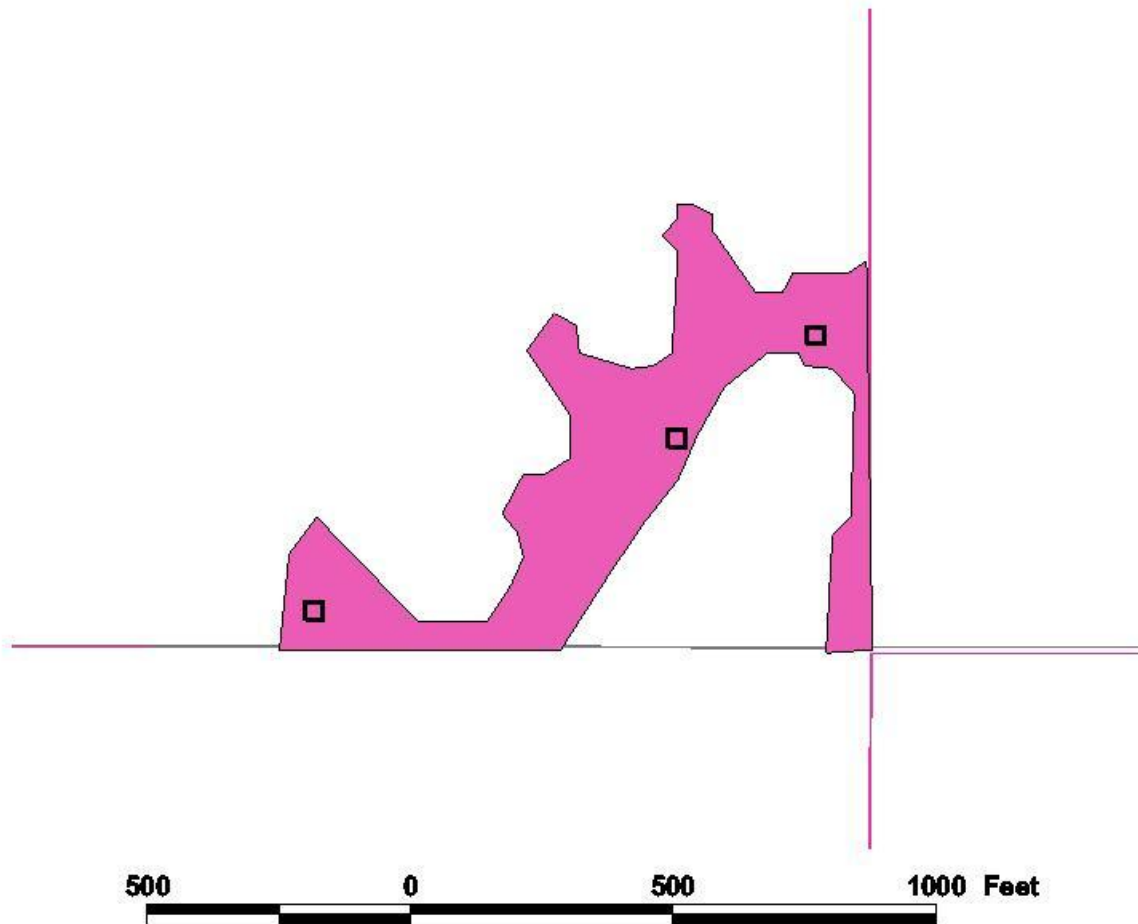
Farm-1








- Sample Points
- Soil 120B
- Walriver
- Roads.shp
- Farmunit.shp



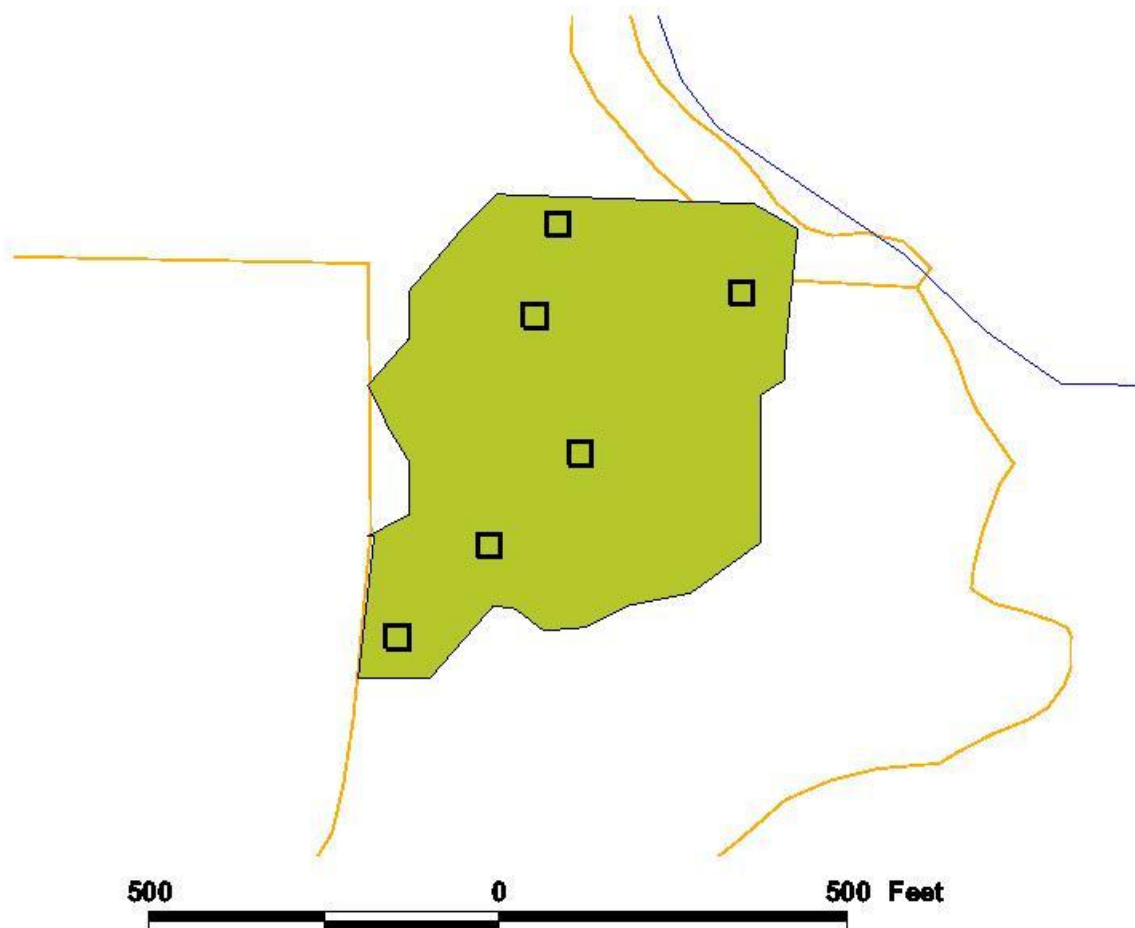
Farm-5



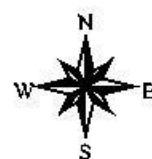
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-  **Soil 120B**
-  **Walriver**
-  **Roads.shp**
-  **Farmunit.shp**



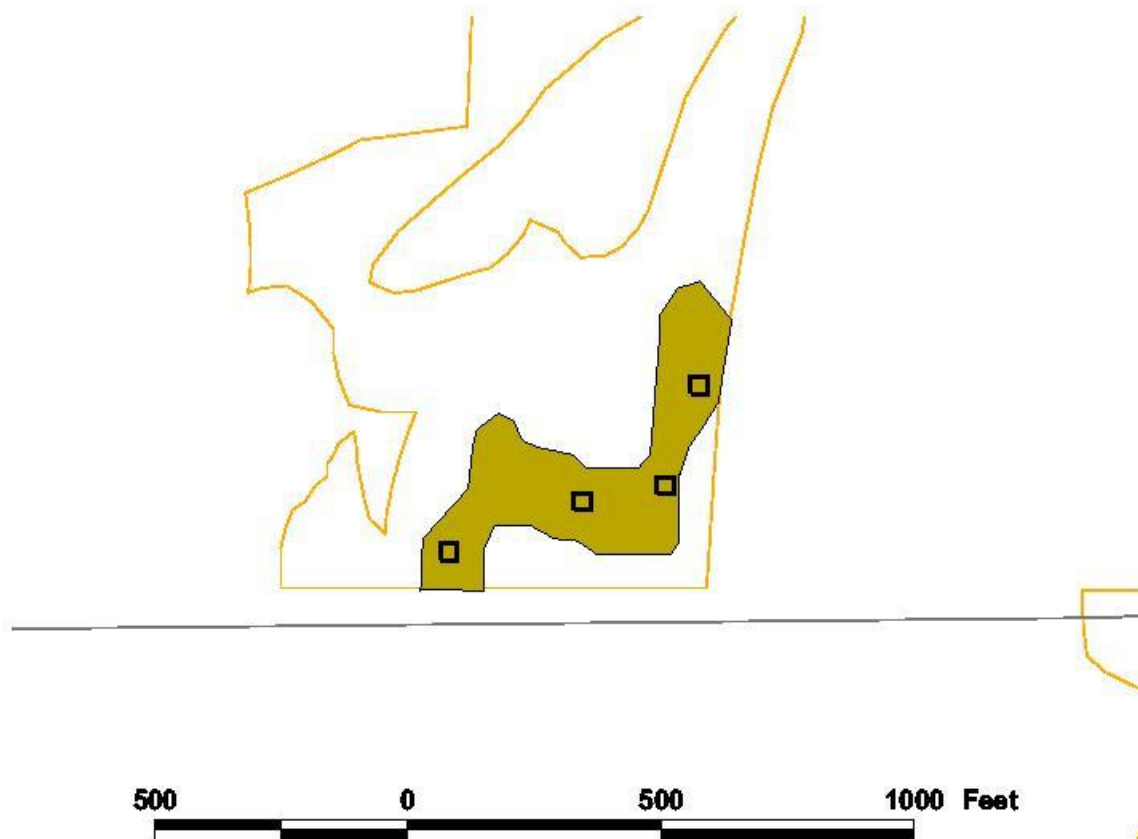
Savanna-1




-  **Sample Points**
-  **Soil 76D2**
-  **Walriver**
-  **Roads.shp**
-  **Savanna.shp**



Savanna-2



-  **Sample Points**
-  **Soil 76D2**
-  **Walriver**
-  **Roads.shp**
-  **Savanna.shp**

